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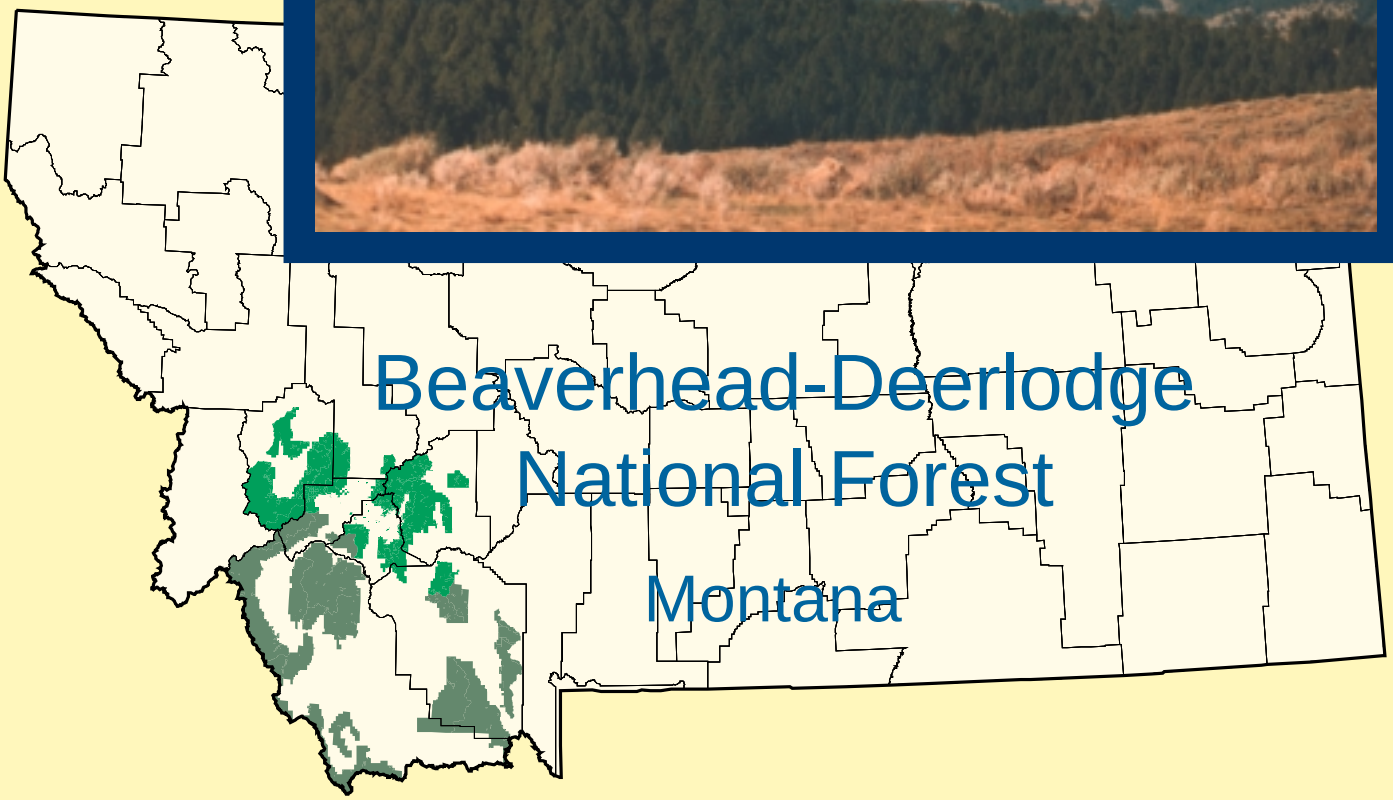
Forest Resources of the Beaverhead-Deerlodge National Forest

Larry T. DeBlander



About the author

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The Interior West Resource Inventory, Monitoring, and Evaluation (IWRIME) Program of the USDA Forest Service, Rocky Mountain Research Station (formerly the Intermountain Research Station), as part of its national Forest Inventory and Analysis (FIA) duties, entered into a cooperative agreement with the Northern Region (Region 1) for the inventory of its National Forests. This report presents the highlights of the Beaverhead-Deerlodge National Forest 1997 inventory, using commonly requested variables and summaries. The data could be summarized in other ways for different purposes (see "For further information" on the inside back cover). The information presented in this report is based solely on the IWRIME inventory sample (USDA 1997a). References are available for supplementary documentation and inventory terminology (USDA 2000a). Additional data collected by the Beaverhead-Deerlodge National Forest and used separately or in combination with IWRIME data may produce varying results. Changes on the forest since the time of the inventory have not been incorporated into this report. For example, it is estimated that approximately 2 percent of the Beaverhead-Deerlodge National Forest burned during the fire season of 2000 (USDA 2000b).

What forest resources are found on the Beaverhead-Deerlodge National Forest?

The Beaverhead-Deerlodge National Forest administers 3,352,288 acres (USDA 1997b, 1998, 2000a) of which 80 percent is forest land and 20 percent is nonforest or water (fig. 1). Seven percent of the total area of the Beaverhead-Deerlodge is in a reserved designation in the Anaconda-Pintler Wilderness and the Lee Metcalf Wilderness. The first part of this report will focus on forest resources of all the forest land on the Beaverhead-Deerlodge, including reserved lands. Lands not reserved from tree utilization, some of which would be considered suitable for timber production, will be addressed in a later section.

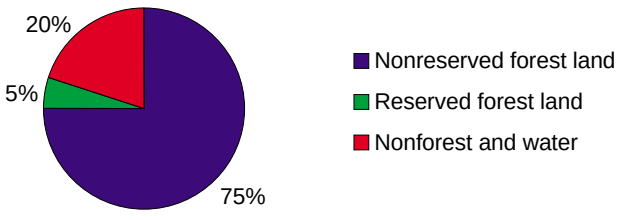

Figure 1—Percent area by land class, Beaverhead-Deerlodge National Forest.

Forest type—Forest resources are often described using a forest type classification. Forest type refers to the predominant tree species in a stand, based on plurality of tree stocking. Stocking is an expression of the extent to which growing space is effectively utilized by live trees. One exception to the single predominant species concept used for classifying forest type applies to sites where Engelmann spruce and subalpine-fir occur together within a stand, and in combination they compose the predominant live-tree stocking (USDA 2000a).

Forest types are dynamic and can change slowly through forest succession, or rapidly due to disturbances such as fire, or insect and disease epidemics. On the Beaverhead-Deerlodge, lodgepole pine at 47 percent is the most common forest type by percentage of total forest land area. Lodgepole pine is followed in abundance by Douglas-fir at 22 percent, spruce-fir at 12 percent, whitebark pine at 11 percent, Engelmann spruce at about 5 percent, and limber pine at 2 percent (fig. 2). Traces of aspen, juniper, and mountain brush woodland types also occur.

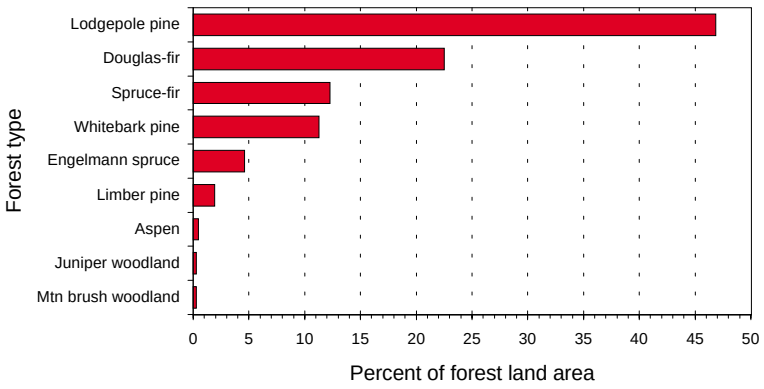

Figure 2—Percent of forest land area by forest type, Beaverhead-Deerlodge National Forest.

Habitat type—Forest communities can be described using a habitat type classification. Habitat type is generally influenced by site characteristics such as slope, aspect, elevation, soils, and climate. Compared to forest types, which describe the species currently occupying the site, habitat types describe lands in terms of their potential to produce similar plant communities at successional climax. More than 100 forest habitat types and phases were described for Montana by Pfister and others (1977). To assist with subregional and landscape level assessments, habitat types from the Northern Region have subsequently been summarized into Westside and Eastside groups based on similarities in natural disturbance regimes, successional patterns, and structural characteristics of mature stands (Jones 1997; USDA 1995). These habitat type groups serve as integrators of the moisture availability and temperature gradients of the biophysical environment (Jones 1997).

The Beaverhead-Deerlodge has more than 70 unique forest habitat types that have been classified into Westside and Eastside habitat type groups. Figure 3 shows area by forest type and habitat type group on the Beaverhead-Deerlodge. The most common habitat type group is the cool and dry group followed by the cold group, occurring on 21 and 14 percent of the forest area, respectively. By using habitat type groups to summarize forest land area, the Beaverhead-Deerlodge can be categorized in a way that theoretically will not change with disturbance or advancing succession.

Number of live trees—Another way to assess forest diversity is by examining the composition of forest land by tree species. Figure 4 shows total number of live trees by species in two diameter-size classes—1.0 to 6.9 inches diameter, and 7.0 inches and greater diameter. Seventy-eight percent of all live trees on the Beaverhead-Deerlodge are between 1.0 and 6.9 inches diameter, and 22 percent are 7.0 inches diameter and greater. Lodgepole pine makes up 50 percent of the total number of trees; subalpine fir, 19 percent; Douglas-fir, 12 percent; whitebark pine, 9 percent; Engelmann spruce, 7 percent; limber pine, 2 percent; and Rocky Mountain juniper, 1 percent. Rocky Mountain maple, curlleaf mahogany, aspen, and black cottonwood combined contribute less than 1 percent. Species that are scarce may not be encountered with the extensive sampling strategy used for this inventory.

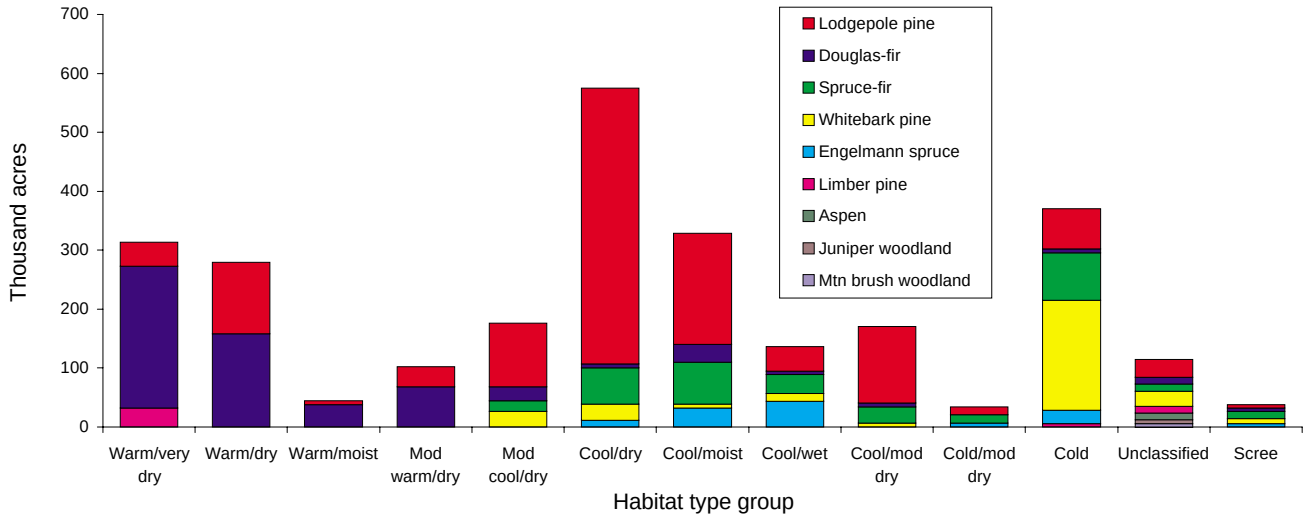

Figure 3—Area of forest land by forest type and habitat type group, Beaverhead-Deerlodge National Forest.

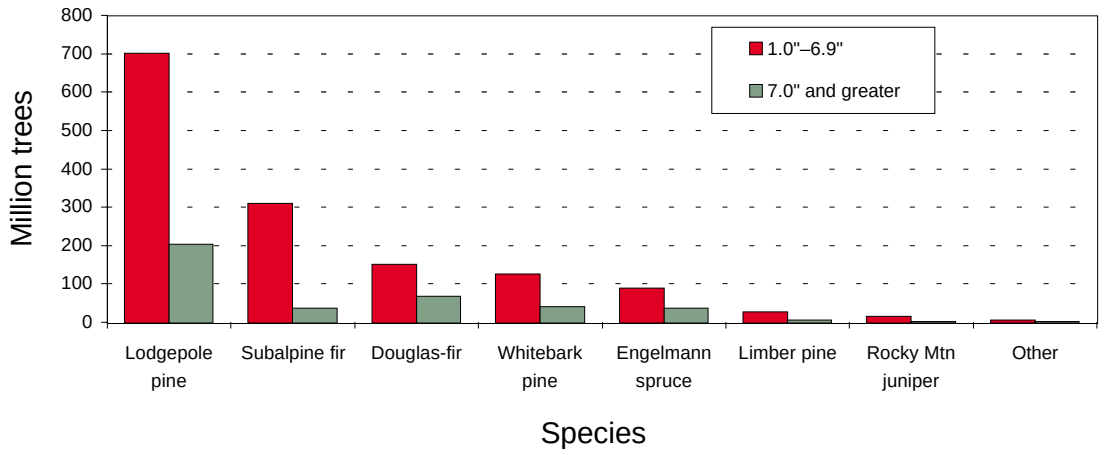

Figure 4—Number of live trees 1.0 inch diameter and greater by species and size class, Beaverhead-Deerlodge National Forest.

Figure 5 shows the number of live trees by species and elevation class. Elevation, mentioned above as a site characteristic affecting habitat type, is associated with variations in local climate. For example, precipitation generally increases with rising elevation, while temperature decreases. These factors have a profound impact on a tree species' ability to compete with other species at various elevations. On the Beaverhead-Deerlodge, the predominantly competing species in order from most to least are lodgepole pine and Douglas-fir at lower elevations, and lodgepole pine, subalpine fir, whitebark pine, Engelmann spruce, and Douglas-fir at higher elevations.

Number and weight of dead trees—Standing and down dead trees are an important component of forest ecosystems, with many uses such as providing habitat for many species of wildlife and functioning as nutrient sinks. There are roughly 71 million standing dead trees (snags) greater than 5.0 inches diameter on the Beaverhead-Deerlodge National Forest. This number includes both hard and soft snags of all species. Many wildlife species are dependent upon snags. The species, size, and density of snags required vary according to the species of wildlife. Because large diameter snags are generally somewhat scarce relative to smaller snags, they tend to be the focus of more attention. Considering snags 11.0 inches diameter or larger, an estimated 5.8 per acre occur on Beaverhead-Deerlodge forest land. Of the very large snags (19.0 inches diameter or larger) there is an estimated 0.5 per acre. The

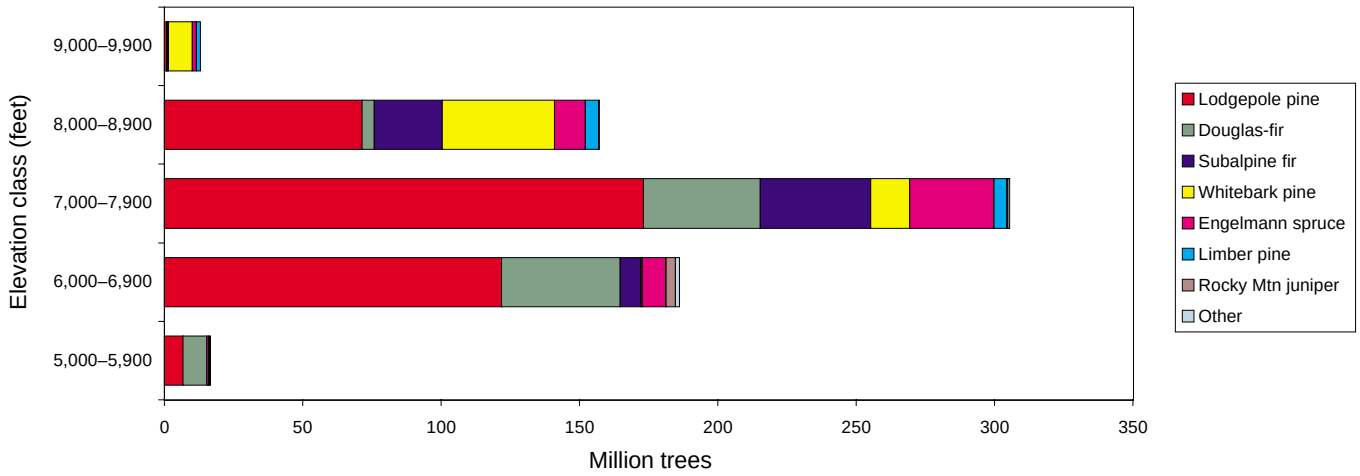

Figure 5—Number of live trees 5.0 inches diameter and greater by species and elevation class, Beaverhead-Deerlodge National Forest. Sample site elevation determined to nearest 100 feet.

most abundant species of snags in the 19-inch and larger category is whitebark pine, followed by Douglas-fir and Engelmann spruce.

The amount of down dead material can contribute significantly to forest fuel loads. There are more than 5.2 million tons of down dead trees on Beaverhead-Deerlodge forest land. This estimate includes the bole and bark of trees 5.0 inches diameter and greater. Figure 6 shows the weight per acre of down dead trees by stand-size class for the six predominant types and all forest types combined. For all stand-size classes combined the spruce-fir type has the highest weight at 3.8 tons per acre, followed by Engelmann spruce at 3.2 tons per acre. For all forest types combined the large tree stand-size class has the highest weight at 2.4 tons per acre, followed by the medium tree class at 1.5 tons per acre. No down dead trees were sampled on nonstocked stand-size classes or on aspen, mountain brush woodland, or juniper woodland forest types.

Size—The size distribution of trees in a stand is an indicator for structural diversity. Figure 7 displays the tree size distribution by diameter class on the Beaverhead-Deerlodge. Overall, there are a higher number of small trees than large trees.

Stand-size class is a classification of forest land based on the predominant diameter size of live trees that contribute to the majority of stocking. Large trees include softwoods 9.0 inches diameter and greater, and hardwoods 11.0 inches diameter and greater; medium trees include softwoods 5.0 to 8.9 inches diameter, and hardwoods 5.0 to 10.9 inches diameter. In terms of stocking, fewer large-diameter trees compared to small-diameter trees are required to fully utilize a site. Figure 8 displays a breakdown of forest land on the Beaverhead-Deerlodge by stand-size class. This figure shows that most stands have a majority of stocking from large trees and that relatively few stands are considered to be nonstocked, such as stands that have been recently harvested or burned.

Figure 9 shows stand-size classes for the five most predominant forest types accounting for the most acreage on the Beaverhead-Deerlodge. Forty percent of the total forest land area is classified in the lodgepole pine large or medium tree category, and 19 percent in the Douglas-fir large- tree category.

Wood volume, biomass, and basal area of live trees—Conventional volume analysis focused on commercial timber species that met certain quality standards (in other words, growing-stock trees). This section emphasizes volume, biomass, and basal area summaries that contain estimates of more tree resources, such as total wood fiber. Volume and basal area summaries include trees 5.0 inches diameter at breast height (d.b.h.) and larger for timber species, and 3.0 inches diameter at root collar (d.r.c.) and larger for tree species such as Rocky Mountain maple or Rocky Mountain juniper, often referred to as woodland species. The net volume of wood in live trees on the Beaverhead-Deerlodge is estimated to be in excess of 6.4 billion cubic feet. Total biomass of wood in live trees on the Beaverhead-Deerlodge National Forest is estimated at over 126 million tons. Biomass estimates include boles, bark, and branches of all live trees including saplings. The following is a breakdown of net cubic-foot volume and tons of biomass by species:

Species	Volume (million cubic feet)	Biomass (million tons)
Lodgepole pine	3,143.2	59.1
Douglas-fir	1,167.3	27.1
Engelmann spruce	992.6	16.4
Subalpine fir	543.9	11.3
Whitebark pine	496.4	10.3
Limber pine	68.5	1.6
Aspen	12.6	.2
Rocky Mountain juniper	5.9	.2
Curlleaf mahogany	.6	T
Black cottonwood	.4	T
Rocky Mountain maple	—	T
Total	6,431.4	126.3

T = Less than 100,000

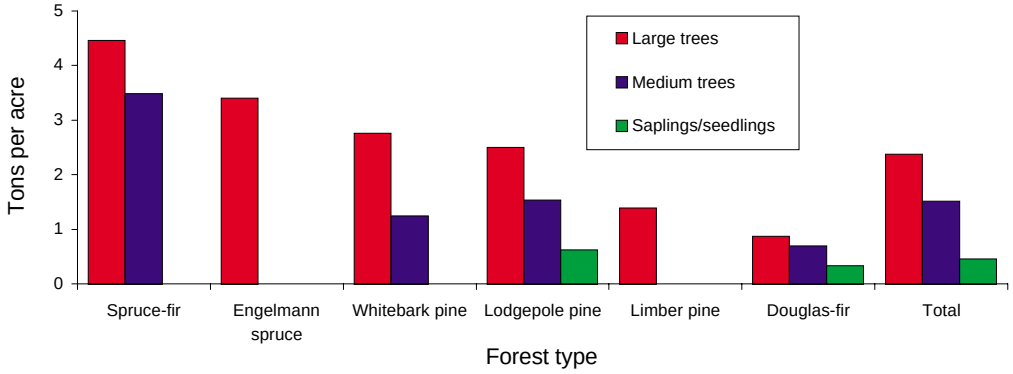

Figure 6—Weight of down dead trees 5.0 inches diameter and greater on forest land by forest type and stand-size class, Beaverhead-Deerlodge National Forest.

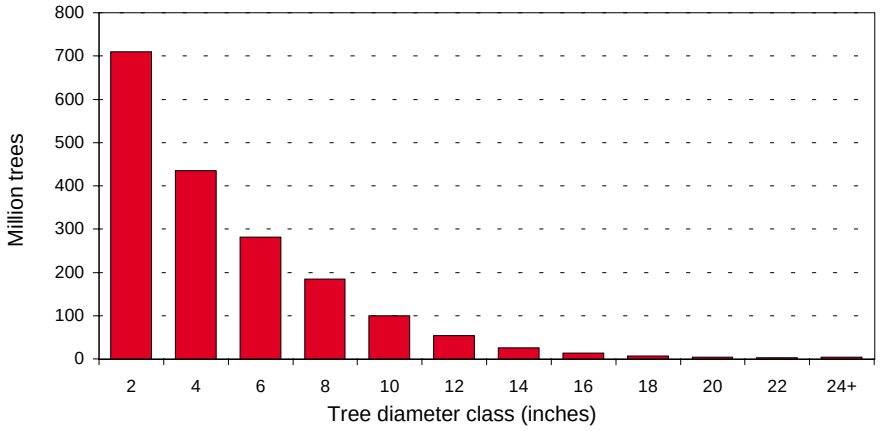

Figure 7—Number of live trees by diameter class, Beaverhead-Deerlodge National Forest.

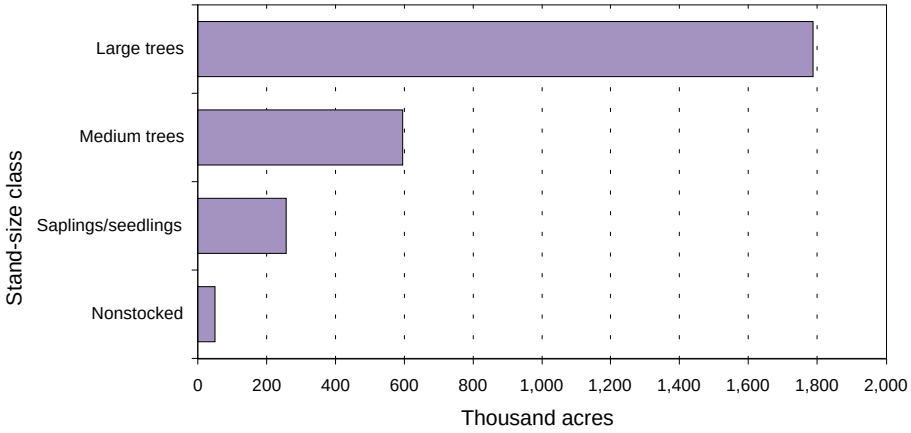

Figure 8—Forest land area by stand-size class, Beaverhead-Deerlodge National Forest.

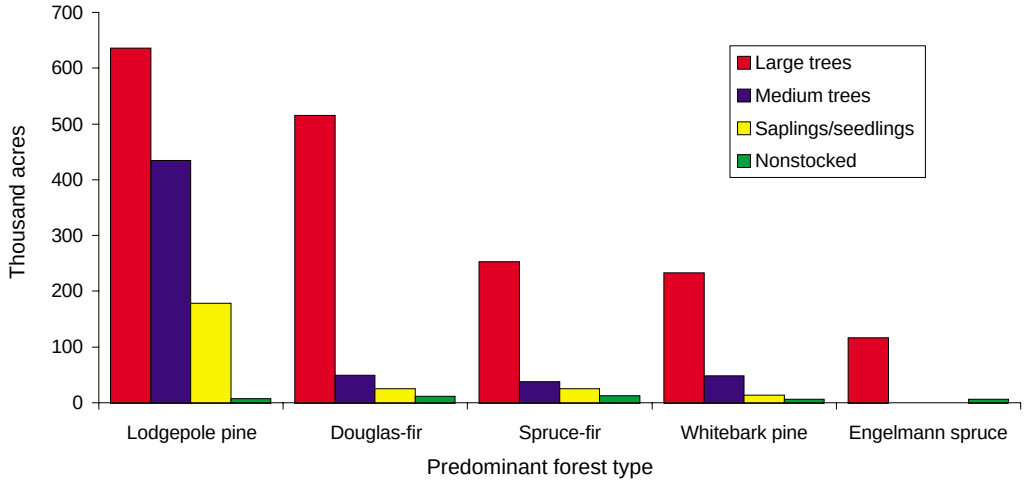

Figure 9—Area of forest land by predominant forest type and stand-size class, Beaverhead-Deerlodge National Forest.

Figure 10 displays the percent net cubic-foot volume of live trees by diameter class. A breakdown by species shows approximately 87 percent of Engelmann spruce, 86 percent of Douglas-fir, 72 percent of whitebark pine, and 55 percent of lodgepole pine volume is in trees 9.0 inches and greater d.b.h. About 54 percent of subalpine fir volume is in trees less than 9.0 inches d.b.h.

Another way to look at wood volume is by forest type, for which estimates per acre can be computed along with basal area (presented in the following table). These numbers include the many different species that can occur together within each forest type. The highest volume per acre on the Beaverhead-Deerlodge is in the Engelmann spruce forest type. The highest basal area per acre is in the spruce-fir forest type. Volume and basal area per acre in aspen, mountain brush woodland, or juniper woodland may not be representative due to small sample sizes.

Forest type	Net cubic-foot volume per acre	Basal area sq. ft. per acre	Number of plots
Engelmann spruce	3,326	123	20
Spruce-fir	3,097	126	52
Lodgepole pine	2,600	113	209
Douglas-fir	1,944	110	99
Whitebark pine	1,666	102	49
Limber pine	1,255	104	9
Aspen	585	36	2
Mountain brush woodland	230	61	1
Juniper woodland	37	14	1
Total			442

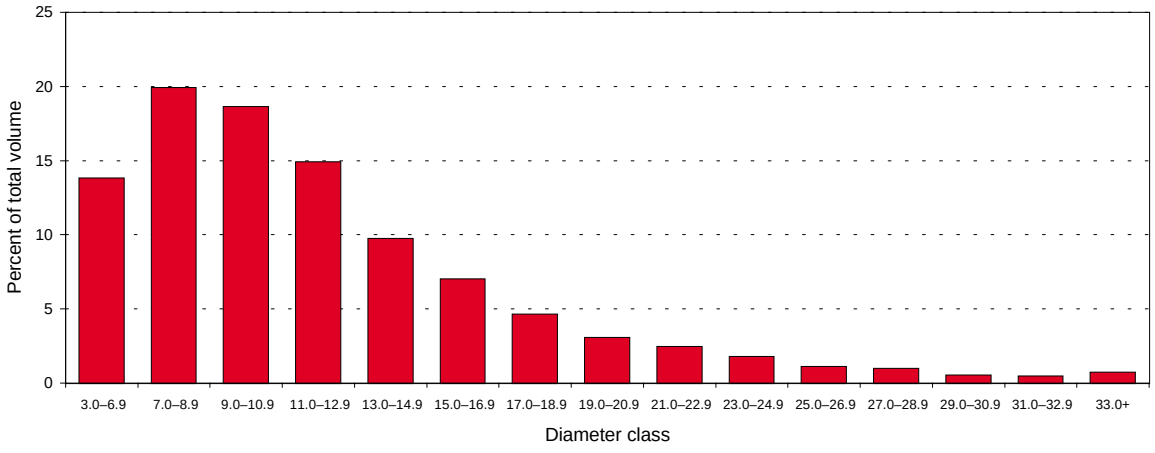

Figure 10—Percent net cubic foot volume of live trees by diameter class, Beaverhead-Deerlodge National Forest.

How does the forest change?

Stocking category—Many factors influence the rate at which trees grow and thrive, or die. As tree size and density increase, competition for available resources also increases. As was mentioned earlier, stocking is an expression of the extent to which growing space on a site is effectively utilized by live trees. Information about stocking can apply to many issues, such as timber production and management, wildlife habitat suitability, and risk of attack by insects or disease. For this analysis, stocking of all live trees is presented in three classes. High stocking sites are those that are 60 or more percent stocked with live trees. Medium stocking sites are those 35 to 60 percent stocked with live trees. Low stocking sites are those that are less than 35 percent stocked with live trees.

The percent area by stocking category and forest type is shown in figure 11. High stocking indicates conditions where tree growth begins to slow and tree vigor starts to decrease, which can make trees more susceptible to attack by insect and disease. By this definition, about 62 percent of all forest land on the Beaverhead-Deerlodge is estimated to be in the high stocking category. This includes about 76 percent of the lodgepole pine, 68 percent of the whitebark pine, and 53 percent of the spruce-fir forest types on the Forest.

Growth—Another measure of forest vigor is net annual growth. Net annual growth is the difference between gross annual growth and losses due to mortality. Gross annual growth of growing-stock trees (5.0 inches d.b.h. and greater) on all forest land of the Beaverhead-Deerlodge is estimated to be 118.8 million cubic feet, and net annual

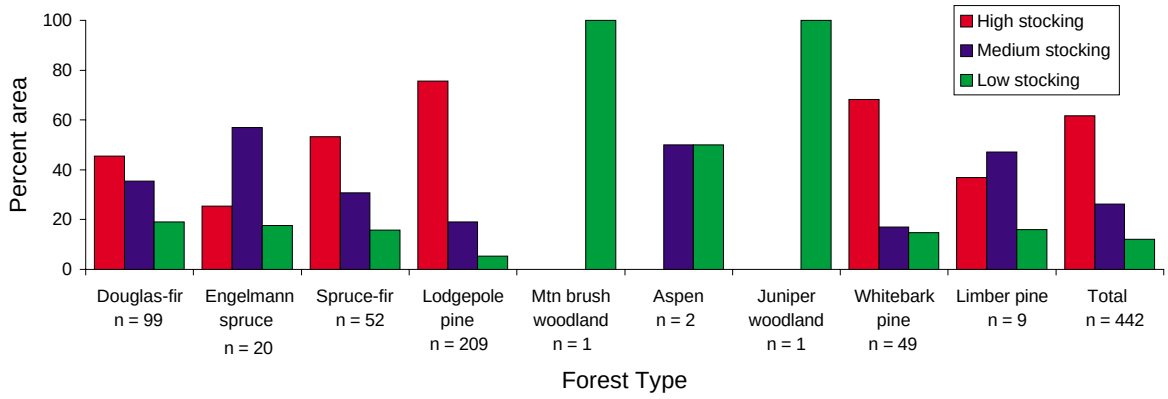

Figure 11—Percent area of live tree stocking category by forest type, Beaverhead-Deerlodge National Forest. Includes number of plots in each type.

growth is 97.4 million cubic feet. Gross annual growth is compared to mortality for five high volume species in figure 12. Mortality on all forest land of the Beaverhead-Deerlodge is about 18 percent of gross annual growth, with the largest mortality to growth ratio for the five high volume species occurring in subalpine fir.

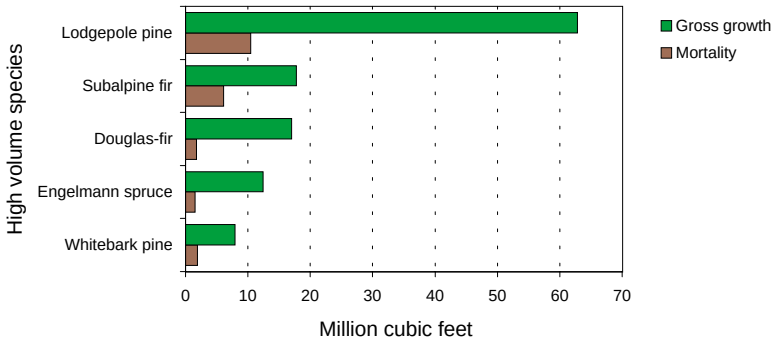

Figure 12—Gross annual growth of growing stock compared to mortality for five high volume species on all forest land, Beaverhead-Deerlodge National Forest.

Mortality—Field crews assess which trees have died in the past 5 years; these trees are used to estimate the average annual mortality. Based on this estimate, in 1996, 21.4 million cubic feet of wood from growing-stock trees (5.0 inches d.b.h. and greater) died on the Beaverhead-Deerlodge. About 50 percent of the mortality was caused by disease, 20 percent by insects, and 16 percent by weather. Seventy-six percent of the mortality occurred in just two species: lodgepole pine and subalpine fir.

Other information about the forest land of the Beaverhead-Deerlodge

Accessibility—All forested plots visited by field crews were assigned a "distance to road" category. Based on this information, it is estimated that 23 percent of the forested area of the Beaverhead-Deerlodge National Forest is less than a half mile from an improved road; 18 percent is between a half and 1 mile; 34 percent is between 1 and 3 miles; 14 percent is between 3 and 5 miles; and 11 percent is greater than 5 miles from an improved road.

Location history—Field crews also make a field observation on each forested plot of the predominant human or natural disturbance that affects the stand. From this it was estimated that 27 percent of the forested area on the Beaverhead-Deerlodge had no visible signs of disturbance; 26 percent had disease damage for its predominant disturbance; 15 percent had evidence of tree cutting; 9 percent had evidence of fire; 6 percent had evidence of wind damage; 6 percent had evidence of weather damage;

and 4 percent each had evidence of insect or animal damage. The remaining 3 percent had evidence of road building, land clearing, mining, or other disturbance.

Understory vegetation—Understory vegetation provides forage and cover for wildlife, contributes to forest fuel load, and can be an indication of the successional stage of the forest community. Field crews visually estimated crown canopy coverage and assigned a percent cover class for three different height classes (layers) of tree seedlings, shrubs, forbs, and graminoids (see USDA 1997a for details). Figure 13 shows the average percent cover of shrubs on forest land by height class (feet) and forest type.

How much forest land is suitable for timber production?

Wood production is one of many important uses of nonreserved forest land on the Beaverhead-Deerlodge. Nonreserved means the land has not been withdrawn from timber utilization through statute or administrative designation. The area of nonreserved forest land is 2,511,787 acres, or 94 percent of the total forest land area of the Beaverhead-Deerlodge. The net volume of growing-stock trees (5.0 inches d.b.h. and greater) on nonreserved forest land is over 5.8 billion cubic feet.

About 33 percent of the nonreserved forest land is actually considered to be suitable for timber production (USDA 1986, 1987). Suitable lands are designated through National Forest planning to have a management emphasis on timber production while maintaining other resource values (USDA 2000a). Field plots that fell within the suitable forest area were identified, and attributes associated with those plots were then summarized to characterize the forest resources of the suitable lands.

Forest type and stand size—In terms of forest type, the composition of suitable forest land is different from that of all forest land. The largest differences are in the lodgepole pine and whitebark pine types. The lodgepole pine type makes up 70 percent of the suitable forest area, but only 47 percent of the total forest area. Conversely, whitebark pine comprises less than 1 percent of the suitable forest area, but makes up 11 percent of the total forest area. The limber pine, aspen, juniper woodland, and mountain brush woodland types occur on all forest land, but do not occur on suitable lands. Stand-size class distribution on suitable lands is similar to that of all forest land.

Volume—The net volume of growing-stock trees (5.0 inches d.b.h. and greater) on suitable lands is estimated to be over 1.9 billion cubic feet, which is about 34 percent of the net volume on nonreserved forest land. The net volume of sawtimber trees (sawtimber volume) on suitable lands is estimated to be over 5.3 billion board feet (Scribner rule). Figure 14 shows the distribution of sawtimber volume on nonreserved forest land by species, compared to that on suitable lands. Lodgepole pine, Douglas-fir, and Engelmann spruce together account for about 94 percent of the total sawtimber volume on suitable lands. Compared to nonreserved forest land only 18 percent of Engelmann spruce, 6 percent of whitebark pine, and 1 percent of limber pine sawtimber volume occur on suitable forest land. In contrast, 40 percent of the lodgepole pine sawtimber volume on the Beaverhead-Deerlodge occurs on suitable forest land. No aspen occurs on suitable forest land and only a trace on nonreserved forest land.

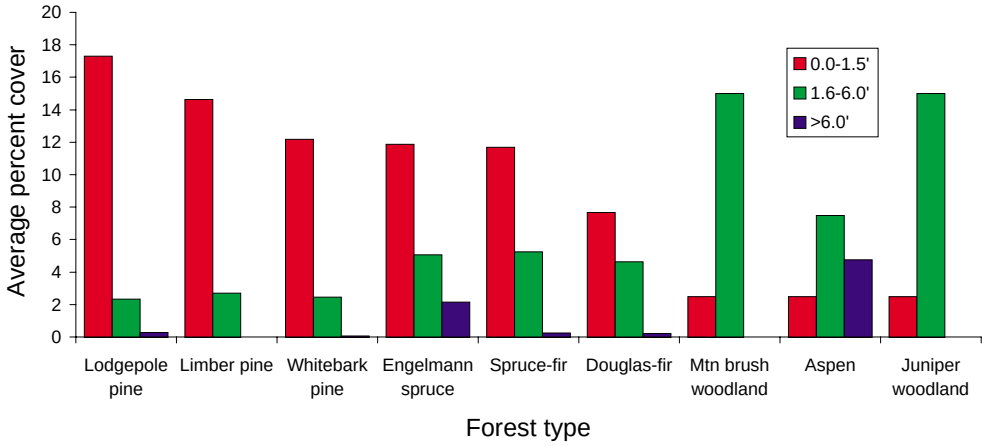

Figure 13—Average percent cover of shrubs on forest land by height class and forest type, Beaverhead-Deerlodge National Forest.

Growth and mortality—Gross annual growth of growing-stock trees (5.0 inches d.b.h. and greater) on nonreserved forest land is estimated to be about 106.8 million cubic feet, and net annual growth is about 87.1 million cubic feet. Annual mortality is over 19.7 million cubic feet, or about 18 percent of gross annual growth on nonreserved forest land. By comparison, gross annual growth on suitable lands is estimated to be over 38.9 million cubic feet, and net annual growth is estimated to be over 31.2 million cubic feet. Annual mortality is about 7.7 million cubic feet or about 20 percent of gross annual growth on suitable forest land.

Gross annual growth of growing-stock trees (5.0 inches d.b.h. and greater) for five high volume species is compared to mortality on nonreserved and suitable lands, in figures 15 and 16, respectively. On suitable forest land Engelmann spruce has the largest ratio of mortality to gross annual growth. No whitebark pine trees were sampled for mortality on suitable lands.

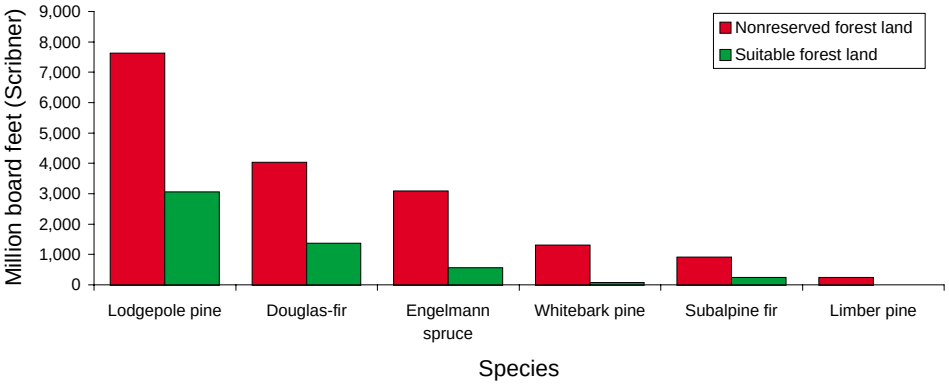

Figure 14—Sawtimber volume on nonreserved forest land compared to sawtimber volume on suitable lands by species, Beaverhead-Deerlodge National Forest.

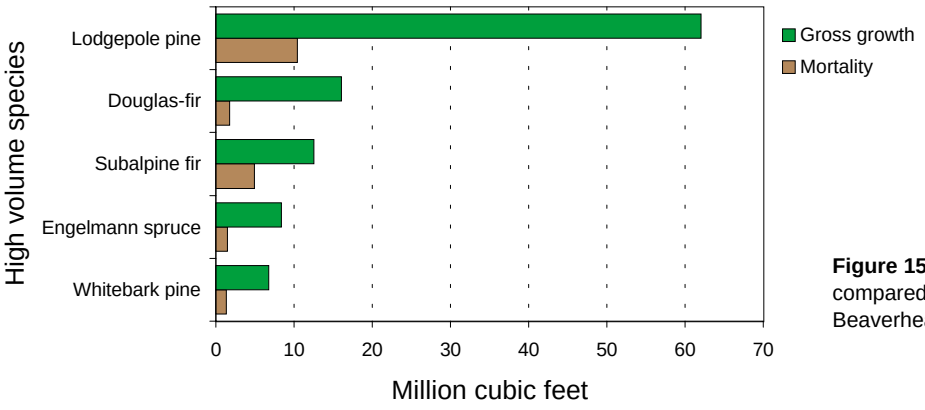

Figure 15—Gross annual growth of growing stock compared to mortality for nonreserved forest land, Beaverhead-Deerlodge National Forest.

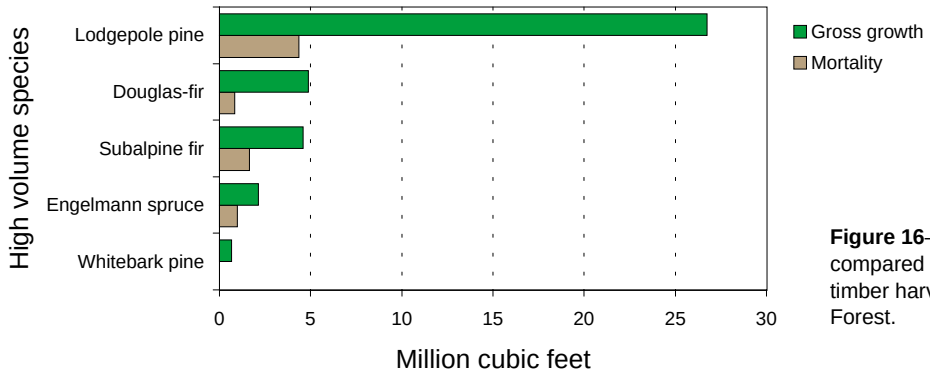

Figure 16—Gross annual growth of growing stock compared to mortality for forest land suitable for timber harvest, Beaverhead-Deerlodge National Forest.

How was the inventory conducted?

FIA inventories provide a statistical-based sample of forest resources across all ownerships that can be used for planning and analyses at local, State, regional, and national levels. IWRIME has not traditionally conducted inventories on National Forest lands in the West, but in Montana, a cooperative agreement with funding and personnel from the Inventory Service Center of the Forest Service Northern Region, made possible an inventory of National Forest System lands, using IWRIME procedures.

IWRIME uses a two-phase sampling procedure for all inventories. Phase one of the inventory is based on a grid of sample points systematically located every 1,000 meters across all lands in the State. Phase one points are assigned ownership and vegetative cover attributes using maps and remotely sensed imagery. Field crews conduct phase two of the inventory on a subsample of the phase one points that occur on forest land. The sampling intensity is one field plot every 5,000 meters, or about every 3 miles. Phase two plots are stratified based on phase one ownership and vegetation information, and weights are assigned to each stratum based on the proportion of phase one points in that stratum. There were 547 field plots on the Beaverhead-Deerlodge using the standard IWRIME grid, of which four were inaccessible. Of the plots field sampled, 442 were forested.

The sample was designed to meet national standards for precision in State and regional estimates of forest attributes. Standard errors, which denote the precision of an estimate, are usually higher for smaller subsets of the data. Percent standard errors for net volume, net annual growth, and annual mortality estimates of growing stock on total forest land, nonreserved forest land, and forest lands suitable for timber production are presented in table 1. Standard errors for other estimates are available upon request (see "For further information" on the inside back cover).

Table 1—Percent standard errors for net volume, net annual growth, and annual mortality of growing-stock trees (5.0 inches d.b.h. and greater) on total forest land, nonreserved forest land, and land suitable for timber production, Beaverhead-Deerlodge National Forest.

Land class	Attribute	Growing-stock volume	Percent standard error
		Cubic feet	
Total forest land	Volume	6,389,302,441	3.7
	Growth	97,399,660	7.2
	Mortality	21,427,117	14.2
Nonreserved forest land	Volume	5,837,352,805	3.7
	Growth	87,121,026	6.9
	Mortality	19,667,090	14.5
Land suitable for timber production	Volume	1,961,052,423	9.1
	Growth	31,196,502	14.2
	Mortality	7,711,792	24.7

Documentation

Jones, J. L. 1997. Classification of regional habitat type groups—an integration of eastside and westside forest classifications. Unpublished report on file at: Flathead National Forest, Kalispell, MT.

Pfister, Robert D.; Kovalchik, Bernard L.; Arno, Stephen F.; and Presby, Richard C. 1977. Forest habitat types of Montana. Gen. Tech. Rep. INT-34. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 174 p.

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Selected data for this forest are part of a national data base that houses information for much of the forest land in the United States. This data base can be accessed on the Internet at the following Web site:

http://www.srsfia.usfs.msstate.edu/scripts/ew.htm

The Rocky Mountain Research Station develops scientific information and technology to improve management, protection, and use of the forests and rangelands. Research is designed to meet the needs of National Forest managers, Federal and State agencies, public and private organizations, academic institutions, industry, and individuals.

Studies accelerate solutions to problems involving ecosystems, range, forests, water, recreation, fire, resource inventory, land reclamation, community sustainability, forest engineering technology, multiple use economics, wildlife and fish habitat, and forest insects and diseases. Studies are conducted cooperatively, and applications may be found worldwide.